General considerations: recording technique

Before starting to record language data, it's crucial that you familiarize yourself with both the technical equipment and the best recording techniques. Only recorded data of a certain quality can be made use of in linguistic analyses for the most diverse and general intents and purposes. This quality control also eases comparison between the data and results coming from the different groups of the project, as well as from other research projects. The following points are intended to establish this standard of quality and comparability and to make sure that it can be followed in all our recordings.

In general, before setting out to make recordings in the field with a new team or new technical equipment, it's worth testing out everything at home first: are all devices working correctly? Do the members of the team know well how to use and handle them? Do they all know their assigned roles and tasks? Does everybody know the script(s) for the experiment(s) and the established recording procedure? A useful rule is not to have more researchers present during the experiment than are necessary / than have assigned roles (which might of course include observers that are there to learn or as supervisors, but their number should be kept to a minimum if possible). In our experiments we have found it useful to have one person who takes care of all the technical matters: setting up the equipment, supervising it during the recording and being responsible for the actual technical act of recording itself. Another person is mainly responsible for the interaction with the speakers, both before and after (giving instructions, opening and closing the session, etc.) and during the experiment (participating in a passive role, as game master or addressee, in the experiment itself). In the following, we will refer to the former role as 'the technician', and to the latter as 'the moderator', whenever necessary.

Technical equipment and other materials: it is crucial that the devices used are capable of producing recordings that follow certain minimal requirements. The recommendations regarding the specific devices, i.e. which brand and model of recorder or microphone to use, are precisely that – recommendations – but an absolutely indispensable and non-negotiable requirement for any recording is that it must be done in accordance with the following standards. By this we mean that the recording device **must** be configured (and hence configurable) in the way laid out here.

Configuration of the recording device: Before recording, the recorder must be configured as specified:

Recording format: we always record in the format PCM .wav, and **never in .mp3**. This is because .mp3 is a compressed recording format, in which a significant part of the acoustic signal relevant for the acoustic analysis is lost. Although the difference in recordings between the two formats may on occasion not be perceivable to untrained ears, it is nonetheless immediately observable in programmes used for acoustic analysis. The most widely used programme for these analyses, *praat* (Boersma & Weenink 2019), does not accept files in .mp3 format.

Sampling rate: 44.1 kHz. This refers to the frequency per second with which an acoustic signal is sampled during the recording. By using a sampling frequency of 44.1 kHz we make sure that the full spectral range of the human voice relevant for speech analysis is recorded accurately, which is why it is the established standard in linguistic recordings.

Bit depth / sample size: 16 bit. This refers to the dynamic resolution of the acoustic signal recorded and it is usually selected together with the recording format: PCM (16 bit). Again, 16 bit is the established standard for linguistic recordings.

Number of channels: we record in mono (just one channel), not in stereo (two channels). This makes the analysis in programmes like *praat* a little easier, but it is not too problematic if we made a recording in stereo, because conversion from stereo to mono is very simple.

Recorder: we recommend using the Zoom H4n Pro, a solid state recorder. It has a very high recording quality and is easy to use. Careful: before recording, make sure that the "stamina" mode is disabled.

Microphone: use a condenser microphone, preferably a directional one (cardioid or unidirectional), for example, the Røde NT1-A, together with its shock mount with pop filter. The microphone connects to the recorder via cable, normally XLR.

Other materials: the majority of recorders use **solid state (flash) memory cards**, like for example Micro SD, to save the recordings on, and **batteries**. It is advisable to use solid state memory, since it is relatively robust compared to optical disks (CD, DVD) or magnetic storage (traditional computer hard drives). It's important to make sure that there is always sufficient space on the memory card for the recording we want to make: an hour of data recorded with the above configurations will take up around 1 GB of space. We recommend using memory cards with at least 4 GB storage capacity. A couple of batteries will normally allow us to use the recorder for 1-2 hours. We highly recommend always bringing a sufficient amount of additional memory cards and batteries to recording sessions, even if it may not seem that you will need them. Also, a **tripod** for the floor or for use on a table is necessary for setting up the microphone and keeping it in place.

Location: the location in which the session takes place has the potential to make or break a successful recording. It's not always possible to record in a location that would be ideal from an acoustic point of view, but it is worth making an effort to select the best available location and to even try to improve the acoustic properties of the one that will be used, especially when it is to serve as location for several recording sessions.

The ideal recording location would be a soundproof chamber in a phonetics lab. However, since we don't have that available in the field, we can try to select the location according to the following criteria: it should be an enclosed (interior) space, silent and without echoes or reverberation. For example, a small room in a house that is not too close to heavily trafficked streets, with thick walls and somewhat away from the center of domestic activity. It's important to reduce noise and ambient sound to the minimum possible. Because of that, it's better not to have other people present in the room than those participating in the recording, and if it's possible and permissible, to even ask other people in the house to try to not make too much noise while the experiment is running. If there is an echo or reverberation in the recording room, for example because it is rather large and empty, or because the walls are thin and/or made of metal, it can be worth our while to try to improve on the acoustics: by hanging towels, bedsheets or other large pieces of cloth on the walls, or by reducing the room size by putting large objects in front of unused areas, in order to diffuse and silence the echo and dampen the reverberation.

External noise cannot always be avoided entirely, and it doesn't do too much damage if it is shortlived and occurs only sporadically. But there are types of environmental noise that have to be avoided at all costs, namely those that are enduring and occur with regular but unpredictable frequency: hissing, static noise, humming, vibrations, whistling, wind, etc. Never do a recording outside in an area where it's windy! The wind isn't just recorded as a swooshing noise among other things, it completely destroys the recording on the parts where it occurs: even a light wind can produce enough pressure for the sensitive membranes of the microphone so that they go into overdrive.

How to record in the best way: in the recording location, the microphone and the recorder must be set up. We have to make sure that no cable is left hanging in the air unnecessarily and that it isn't in the way of anyone who might move around during the session, because cable movement may be heard in the recording. The microphone is set up in its suspension (using a small tripod or stand for use on a table or a larger on for the floor). The microphone is directed at the speaker(s), as close as possible but without it inconveniencing the speakers or going into overdrive at normal speech volume. If there is only one speaker, the microphone is directed directly towards them, if there are two, it should be positioned so that it can optimally record both according to its acoustic profile. Once the equipment is set up and the speakers have taken their seats, we recommend starting to record right away and to only stop recording once the entire session is complete. It is far easier to later edit out unnecessary parts from the recording than it is to repeat parts of the experiment that weren't recorded because the technician didn't pay attention. During the recording, nobody should make unnecessary noise or movements. This is true for the speakers, but even more so for the researchers. The technician needs to be looking at the monitor screen of the recorder during the recording. Loud noise or voices can cause the recording to go into overdrive, which means a part of the recording is unusable. The volume of the recording is shown dynamically on the screen of the recorder, so we can tell when it is in danger of overdriving. In order to prevent this from happening, it is easiest to record with a configuration where the recording volume is not too high, and not in danger of going into overdrive even when speakers are speaking up (another reason not to put the microphone too close to their mouths). Here again, it is infinitely easier to convert a recording with a low volume into one where everything can be heard well than it is to try to salvage something from parts of a recording that went into overdrive.

References / further reading:

Boersma, Paul & David Weenink. 2019. Praat 6.0.56: Doing Phonetics by Computer. http://www.fon.hum.uva.nl/praat/.

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Version 26/06/2019